Advanced Solid State Lighting for AES Deep Space Hab

Completed Technology Project (2013 - 2014)

Project Introduction

The advanced Solid State Lighting (SSL) assemblies augmented 2nd generation modules under development for the Advanced Exploration Systems Deep Space Habitat in using color therapy to synchronize crew circadian rhythms. Current RGB LED technology does not produce sufficient brightness to adequately address general lighting in addition to color therapy. The intent is to address both through a mix of white and RGB LEDs designing for fully addressable alertness/relaxation levels as well as more dramatic circadian shifts.

Advanced solid state lighting assemblies were built for inclusion in the Advanced Exploration Systems ISS-derived Deep Space Habitat concept demonstrator. The augmented second generation assemblies were modified versions of the first generation custom commercial lighting, using the same form factor, power supply, and balanced white light LED components. This effort replaced the manual adjustments with an interface to the Deep Space Habitat (DSH) Concept Demonstrator avionics allowing full control of the general purpose white lights to simulate a full terrestrial day. Modifications allowed additional RGB lighting to be added to the existing fixtures and accessed through the same avionics. Circadian synchronization can be addressed on an as needed basis, obviating crew stress of non-white light dominance. The completed lights were then installed in the concept demonstrator at Marshall Space Flight Center. They were part of the ISS-derived DSH concept assessment.

These lights were then evaluated by Dr. Phil Sloane of UNC-Chapel Hill and Dr. Mariana Figuiero of the Lighting Research Center at RPI. The team at LRC/RPI made measurements and the joint UNC/RPI team provided a subjective assessment based on their expertise with sleep disorders and light therapy.

Anticipated Benefits

This project benefits the next generation of lighting for ISS. The SSLAs scheduled to launch in 2016 are only manually selectable. There is no simulated diurnal cycle to assist with circadian entrainment which may assist in alleviating some symptoms of isolation and help with crew sleep.

For long duration space flight beyond low earth orbit, sleep cycles and circadian entrainment must be optimized to keep crew functioning at peak efficiency. Similarly, crew must have as familiar an environment as possible to alleviate feeling of alienation. Lighting simulating a modified diurnal cycle, capable of using light therapy to facilitate crew day shifting and provide sleep therapy is required.

Any commercial space partner interested in long term habitation of space will need to assure the efficacy of crew and have a desire to ensure sufficient

Augmented 2nd generation Custom Commercial Solid State Lighting Assembly for

Table of Contents

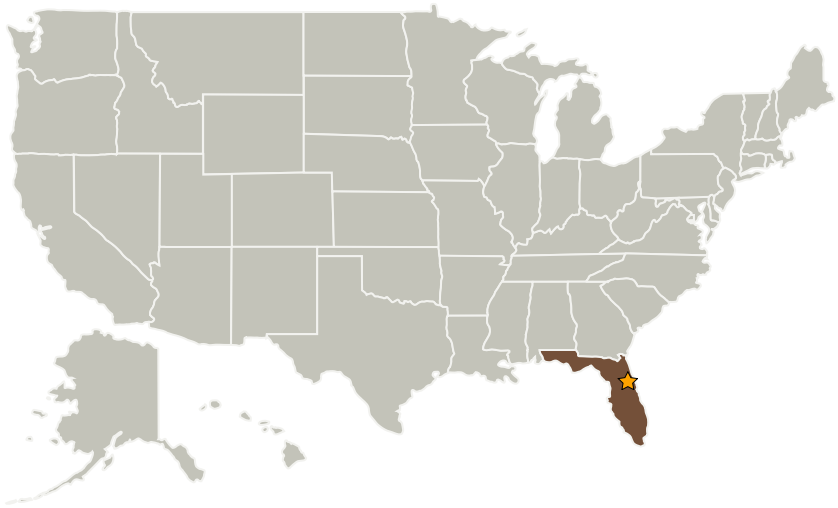
Advanced Solid State Lighting for AES Deep Space Hab

Completed Technology Project (2013 - 2014)

restful sleep.

This technology has benefits to assist with any agency using shift workers. It has the potential to augment alertness by suppressing melatonin production.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations
Florida

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Independent Research & Development: KSC IRAD

Project Management

Program Manager:

Barbara L Brown

Project Manager:

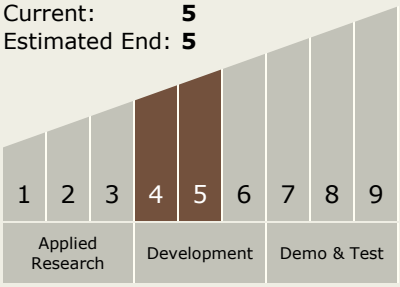
Pamela A Mullenix

Principal Investigator:

Eirik Holbert

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Advanced Solid State Lighting for AES Deep Space Hab

Completed Technology Project (2013 - 2014)

Images

Solid State Light for Circadian Entrainment
Augmented 2nd generation Custom Commercial Solid State Lighting Assembly for *(https://techport.nasa.gov/image/4034)*

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.4 Habitation Systems